PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Charming e-cigarette users with distorted science: A survey examining social media platform use, nicotine-related misinformation, and attitudes towards the tobacco industry
AUTHORS	Silver, Nathan; Kierstead, Elexis; Briggs, Jodie; Schillo, Barbara

VERSION 1 – REVIEW

REVIEWER	Kim, Joon Kyoung University of Rhode Island
REVIEW RETURNED	23-Dec-2021

GENERAL COMMENTS	The manuscript deals with timely important issues including COVID-19 related misinformation and young adults' view of tobacco industry. The background is thorough and provides strong study rationales. The method and data analyses are adequate. I have a few minor comments, mostly regarding the discussion. The authors found that the relationship between social media use and recall and belief in distorted science varies depending on social media platforms, which is very interesting. However, I believe the authors should address that their participants did not often use Reddit and Twitter despite their significant relationships with information recall and belief. This is consistent with the Pew Research Center's recent social media data. https://www.pewresearch.org/internet/2021/04/07/social-media-use-in-2021/ Although young adults more often use Twitter and Reddit than older generations do, less than 50% of young adults use those platforms. When it comes to the authors' sample means (Reddit: M = 0.5, Twitter: M = 0.65), the frequency of using Reddit and Twitter is relatively low compared to other social media platforms such as Instagram (M = 1.41) and Facebook (M = 1.73). More importantly, the authors assume that social media is largely responsible for misinformation belief and recall. However, it is very probable that individuals learn about tobacco products and tobacco industry from other than social media sources, such as news media or peers. Without measuring and control for other potential information sources, it might be difficult to argue that social media is responsible for misinformation. The authors should address this as a limitation. The authors found many interesting results, however some of them were not addressed in the discussion section. For instance, the authors reported some racial and gender differences in COVID-19-related distorted science recall and beliefs. However, the authors did not address them in the discussion section, and I am curious what hose demographic differences tell us and why such differences occurred.

Also, I believe more practical implications would help improve the quality of the manuscript and benefit readers. Based on the relationship between certain social media platforms and recall and belief in distorted science, what would authors suggest? For example, more implication regarding tobacco control, need for more public campaigns, regulating on tobacco industry's corporate social responsibility activities (if possible). Or even social media platforms' self-regulation.
I hope my comments will help. I believe the manuscript offers many novel and interesting findings regarding timely important issues. Once the authors offer more implications, I believe the manuscript would be a good fit for the journal.

More minor issue
Line 106 =twitter > Twitter

REVIEWER	Marynak, Kristy National Center for Chronic Disease Prevention and Health Promotion
REVIEW RETURNED	29-Dec-2021

| GENERAL COMMENTS | This is an important and timely study that has been thoroughly researched and explained. I have several minor comments and suggestions to strengthen and clarify findings.

Strengths and limitations – it is a stretch to call the sample size (1,225) "large" – it is adequate.
It is unclear that favorable beliefs about the industry translate into support for regulation "by extension" which was not measured in this study. THe discussion provides more justification for this statement, but the intro could add 1-2 sentences to make the connection.
It is important to qualify that the evidence supports NRT as effective primarily for adult use, and the public health concerns about nicotine use are around youth and young adults and pregnant women.
Lines 82-83: More evidence needed to justify "deliberate attempt to undermine regulatory efforts" – clearly they are deliberate attempts to profit from the sale of their products by undermining health concerns, but the link to regulation is not clear in the intro. It's enough, however, that these are deceptive marketing practices designed to target youth and attract a new pipeline of "addicted for life" users.

"nicotine can harm the cardiovascular system" – suggest relying on systematic review findings such as that from the 2019 NAM report, which didn't make such strong conclusions based on the totality of available evidence.

Discussion – I concur with the authors' selection of the most important conclusion, which I had also drawn in reading the results, that 1 in 3 believed nicotine to be no more harmful than coffee, and that 1 in 4 believed nicotine to be useful as a treatment for mood disorders. While the industry plays a leading role in perpetuating these beliefs, they are also perpetuated by the lay public and medical providers. An area for future research that could be discussed is to assess these beliefs among influencers of young people, including physicians and parents. |

		Discussion and intro – "affordances" of social media are mentioned but not explained. Reference to literature and more explanation are needed for unfamiliar readers. Were there differences in characteristics between Reddit vs other users? While I agree that Reddit can be a place to correct misinformation, it is unclear from this study whether it will miss those who are most likely to believe misinformation from other platforms, as reddit was used by less than 1/3 of sample. Those who failed the attention checks were excluded. Did they complete the survey, and if so was a sensitivity analysis conducted to assess results among this group? As it was such a large group who were excluded, these may be most susceptible to misinformation. The discussion and conclusions represent in my opinion a missed opportunity to amplify the bold and actionable recommendations in the recent Surgeon General's Advisory on Misinformation. At present, the implications of findings and next steps for researchers and practitioners are not well defined and could be aided by a discussion of the advisory's recommendations which are directly applicable to the present study.

VERSION 1 – AUTHOR RESPONSE

#	Comment	Response
	Reviewer #1	
1	The manuscript deals with timely important issues including COVID-19 related misinformation and young adults' view of tobacco industry. The background is thorough and provides strong study rationales. The method and data analyses are adequate. I have a few minor comments, mostly regarding the discussion.	*n/a*
2	The authors found that the relationship between social media use and recall and belief in distorted science varies depending on social media platforms, which is very interesting. However, I believe the authors should address that their participants did not often use Reddit and Twitter despite their significant relationships with information recall and belief. This is consistent with the Pew Research Center's recent social media data. https://www.pewresearch.org/internet/2021/04/07/social-media-use-in-2021/	*Thank you for this perspective, we have incorporated this context into our discussion.*

	Although young adults more often use Twitter and Reddit than older generations do, less than 50% of young adults use those platforms. When it comes to the authors' sample means (Reddit: M = 0.5, Twitter: M = 0.65), the frequency of using Reddit and Twitter is relatively low compared to other social media platforms such as Instagram (M = 1.41) and Facebook (M = 1.73).	
3	More importantly, the authors assume that social media is largely responsible for misinformation belief and recall. However, it is very probable that individuals learn about tobacco products and tobacco industry from other than social media sources, such as news media or peers. Without measuring and control for other potential information sources, it might be difficult to argue that social media is responsible for misinformation. The authors should address this as a limitation.	*We have added a mention of this limitation in our limitations section. Although it is possible that the participants did not observe the misinformation on social media, the relationship between social media and misinformation is well-documented in research and it is likely that social media played a role in the global dissemination of that piece of information (Kavuluru et al., 2021; Soule et al., 2020). This justifies our greater focus, despite not limiting our measurement to misinformation observed on social media. We highlight in the limitations that our data demonstrate a relationship, but that we do not necessarily provide evidence that such information exposure was from social media.*
4	The authors found many interesting results, however some of them were not addressed in the discussion section. For instance, the authors reported some racial and gender differences in COVID-19-related distorted science recall and beliefs. However, the authors did not address them in the discussion section, and I am curious what those demographic differences tell us and why such differences occurred.	*We included a mention of these interesting results in our discussion section. However, we hesitate to hypothesize on the etiology of these demographic differences given the limited inferences we can make from a sample that isn't necessarily representative. Our sample size of Black and Hispanic participants is small enough that we can't make population-level claims regarding recall and belief of misinformation and industry beliefs. Tobacco use disparities often follow race, gender, and education, leading us to control for these factors in our analyses. Therefore, we can be more confident that known demographic differences are not driving our results regarding misinformation and social media than we can about the generalizability of observed demographic differences to the broader population. Nonetheless, we recognize the importance of these differences and thus emphasize the importance of future research in this area.*
5	Also, I believe more practical implications would help improve the quality of the manuscript and benefit readers. Based on the relationship between certain social media platforms and recall and belief in distorted science, what would authors suggest? For example, more implication regarding tobacco	*We have added a brief discussion of practical implications of this study including the application of inoculation, expert correction and news literacy campaigns both from previous*

	control, need for more public campaigns, regulating on tobacco industry's corporate social responsibility activities (if possible). Or even social media platforms' self-regulation.	*research and the recent Surgeon General's Report on Health Misinformation.*
6	I hope my comments will help. I believe the manuscript offers many novel and interesting findings regarding timely important issues. Once the authors offer more implications, I believe the manuscript would be a good fit for the journal.	*Thank you for your comments, they have been very helpful in shaping our manuscript.*
7	Line 106 =twitter > Twitter	*We have made this revision.*
Reviewer #2		
1	This is an important and timely study that has been thoroughly researched and explained. I have several minor comments and suggestions to strengthen and clarify findings.	*Thank you for your comments.*
2	Strengths and limitations – it is a stretch to call the sample size (1,225) "large" – it is adequate.	*We have softened the language around sample size.*
3	It is unclear that favorable beliefs about the industry translate into support for regulation "by extension" which was not measured in this study. THe discussion provides more justification for this statement, but the intro could add 1-2 sentences to make the connection.	*Prior research has identified a connection between tobacco industry denormalization beliefs and support for stronger tobacco control policy. We have included reference to this publication in our discussion, and have added a brief paragraph making this connection in the introduction as well.*
4	It is important to qualify that the evidence supports NRT as effective primarily for adult use, and the public health concerns about nicotine use are around youth and young adults and pregnant women.	*We have clarified the effectiveness of NRT for adult cessation and reworded our discussion of the risks posed by nicotine use to the risks inherent to nicotine specifically (beyond methods of ingestion). We opted not to elaborate on specific risks to pregnant women given research findings suggesting that NRT for cessation among pregnant women is likely safe, especially in comparison to smoking (See Tran et al, 2020 in BMC medicine). We focus instead on the utility of NRT for adult cessation rather than recreational use.*
5	Lines 82-83: More evidence needed to justify "deliberate attempt to undermine regulatory efforts" – clearly they are deliberate attempts to profit from the sale of their products by undermining health concerns, but the link to regulation is not clear in the intro. It's enough, however, that these are deceptive	*We have removed the claim that deceptive marketing is a deliberate attempt to undermine regulatory efforts. In addition to adding citations documenting these deceptive marketing practices, we soften the language to say that such practices "discount the inherent risks posed by nicotine, particularly to youth and*

	marketing practices designed to target youth and attract a new pipeline of "addicted for life" users.	*young adults, threatening to addict new users for life."*
6	"nicotine can harm the cardiovascular system" – suggest relying on systematic review findings such as that from the 2019 NAM report, which didn't make such strong conclusions based on the totality of available evidence.	*We have softened the language and have added a reference to the National Academy of Science and Medicine Public Health Consequences of E-cigarettes report.*
7	Discussion – I concur with the authors' selection of the most important conclusion, which I had also drawn in reading the results, that 1 in 3 believed nicotine to be no more harmful than coffee, and that 1 in 4 believed nicotine to be useful as a treatment for mood disorders. While the industry plays a leading role in perpetuating these beliefs, they are also perpetuated by the lay public and medical providers. An area for future research that could be discussed is to assess these beliefs among influencers of young people, including physicians and parents.	*Future research directions on continuing to examine and understand the perceptions of nicotine as divorced from smoking have been included as well as a mention of understanding the role of social environment (both formal and informal information channels) surrounding youth and young adults in formulating these perceptions.*
8	Discussion and intro – "affordances" of social media are mentioned but not explained. Reference to literature and more explanation are needed for unfamiliar readers.	*Clarifying language has been added to describe what is meant by "affordances." Since people rather than the social media content were the focus of this piece, we do not want to focus too much attention on the technological affordances literature, as our main suggestion is that given findings at the person level, future research between mediums using the affordance framework would likely provide a useful direction to build on our findings. We add a brief definition before using the term "affordances", as well as a citation for the handbook for applying affordance-based frameworks in research practice.*
9	Were there differences in characteristics between Reddit vs other users? While I agree that Reddit can be a place to correct misinformation, it is unclear from this study whether it will miss those who are most likely to believe misinformation from other platforms, as reddit was used by less than 1/3 of sample.	*Upon a second look, we agree with the reviewer that this study does not provide evidence that Reddit can be used to dispel misinformation. Rather we show evidence that Reddit users were less likely to believe specific misinformation surrounding nicotine. Although it is possible that Reddit content may help dispel misinformation, as the reviewer points out, exposure to Reddit content is skewed young, educated, and white. Moreover, it is likely that Reddit's content moderation may simply have kept this misinformation out rather than dispelled it. We thus temper our claims about the use of social media to dispel misinformation (we're not wholly convinced of this premise, and this study does not provide strong evidence in support of*

			it). We instead focus on the need for future research to examine different platform characteristics (affordances) as potential mechanisms that affect the dissemination of misinformation such as Reddit's moderated forums (media gatekeeping) and long versus short form content.
			With regards to demographic differences in Reddit users versus non-Reddit users, this is another reason for using demographic covariates in our models. Reddit users are not representative of the population as a whole, but holding constant race, gender, education, and use of other social media platforms, Reddit use was associated with lower recall and belief in distorted science and misinformation about nicotine.
10		Those who failed the attention checks were excluded. Did they complete the survey, and if so was a sensitivity analysis conducted to assess results among this group? As it was such a large group who were excluded, these may be most susceptible to misinformation.	*Given the goal of our attention checks are to eliminate non-thoughtful response sets that would otherwise contribute noise to our findings, we opt to draw a hardline for inclusion. The attention checks are quite hard to miss for respondents even remotely paying attention to the survey. Thus, any responses available for those eliminated for failing attention checks are suspect. Moreover, industry attitudes and social media use were measured towards the end of the survey, and don't include any responses from people who failed attention checks (those who failed were redirected to the end of the survey). It is thus not possible to run exact sensitivity analyses testing whether our findings hold with and without exclusion of those who failed attention checks. However, in the interest of transparency we conducted post-hoc comparisons between "good complete" response sets and those removed for failing attention checks on 2 versions of each of our four distorted science indices. We used independent samples t-tests to compare the number of items recalled between good completes and eliminated respondents, and chi square difference tests comparing the number of respondents from each group who recalled or believed one or more distorted science claims—two different operationalizations of the same general construct.*

Recalling distorted science about nicotine

- *No significant difference in the number of claims recalled*
- *Those who failed attention check were less likely to recall at least one claim $X2= 7.97, p = 0.006$*

Believing distorted science about nicotine

- *Those who failed attention check believed more claims on average than good completes, $t(df) = 2.62(1872), p = 0.0089$*
- *No significant difference between groups for believing one or more claims*

Recalling distorted science about COVID and nicotine

- *Those who failed attention checks recalled more claims on average than good completes, $t(df) = 6.72(1872), p < .001$*
- *Those who failed attention checks were more likely to recall at least one claim than good completes, $X2 = 52.81, p < .0001$*

Believing distorted science about COVID and nicotine

- *Those who failed attention checks believed more claims on average than good completes, $t(df) = 9.72(1872), p < .001$*
- *Those who failed attention checks more likely to believe at least one claim than good completes $X2 = 89, p < .0001$*

The reviewer's suggestion is indeed accurate (with one exception), as on the whole, those who failed attention checks were more likely to both recall and believe distorted scientific claims. Ultimately, we believe this mildly strengthens our findings, as the prevalence of distorted science beliefs reported is likely a conservative estimate. Of course, it's difficult to rule out that inattentive survey respondents are also dispositionally inattentive web browsers who are more sensitive to misinformation—an interesting premise likely not well-answered by an online opt-in survey. Rather than include this analysis as post-hoc analyses, we instead elaborate on our initial comment regarding the limitations of opt-in panels. Given limited space, we'd prefer not to include these analyses in the

		manuscript. The need for attention checks is a limitation of the methodology that merits attention, particularly for misinformation researchers hoping to create more robust research designs. However, such a discussion is beyond the scope of this manuscript.
11	The discussion and conclusions represent in my opinion a missed opportunity to amplify the bold and actionable recommendations in the recent Surgeon General's Advisory on Misinformation. At present, the implications of findings and next steps for researchers and practitioners are not well defined and could be aided by a discussion of the advisory's recommendations which are directly applicable to the present study.	*We add a discussion of the Surgeon General's report to the discussion, specifically highlighting the need for prebunking (inoculation) strategies and continued monitoring of misinformation and the special populations they reach.*

VERSION 2 – REVIEW

REVIEWER	Kim, Joon Kyoung University of Rhode Island
REVIEW RETURNED	23-Mar-2022

GENERAL COMMENTS	The authors revised the manuscript substantially and the manuscript has been substantially improved as well. My previous comments were mainly about some limitations of the study and practical implications, and the authors adequately addressed the issues.

REVIEWER	Marynak, Kristy National Center for Chronic Disease Prevention and Health Promotion
REVIEW RETURNED	10-Mar-2022

GENERAL COMMENTS	thorough revision responsive to all comments. Stronger manuscript.